

**Chemistry 302: Physical Chemistry II (Spring 2022)**  
Department of Chemistry and Biochemistry, Loyola University Chicago

Instructor: Dr. Pengfei Li  
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Email: [pli4@luc.edu](mailto:pli4@luc.edu)  
Telephone: 773-508-3785  
Lectures: 001: Tuesday and Thursday 10:00 AM-11:15 AM, Online (01/18-01/30)  
or Flanner Hall-105 (1/31 and after)  
Discussions: 002: Tuesday 11:30 AM-12:20 PM, Online (01/18-01/30)  
or Flanner Hall-105 (1/31 and after)  
Office Hours: Tuesday 3:15 PM-4:15 PM, Online, **or by appointment**

*Please see the Sakai site for up-to-date information and posts.*

**Course Prerequisites:** CHEM 222 (or CHEM 224 and 226), PHYS 112 or 112K, and MATH 162. If you have not completed these course prerequisites, you may be administratively dropped from the class. Please discuss this with the instructor immediately!

**Required Textbook:** “Atkins' Physical Chemistry Volume 2: Quantum Chemistry, Spectroscopy, and Statistical Thermodynamics”, 11<sup>th</sup> edition, by Peter Atkins, Julio de Paula, and James Keeler, Oxford University Press, 2018, ISBN: 978-0-19-881790-1.

**Require Materials:** A calculator capable of scientific notation.

**Required Software:** Zoom.

**Course Overview:** Physical chemistry is a chemistry discipline that uses physical principles to understand chemical phenomena. This class aims to enable the students to understand the fundamental principles of physical chemistry and apply them to interpret chemical phenomena as well as solve chemical problems. We will cover fundamental knowledge about physical chemistry, mainly quantum mechanics and molecular spectroscopy, along with their applications in chemical systems. Specifically, a tentative schedule of lectures is shown in the end of this syllabus. Your attendance at lectures and discussions is expected. The correct answers of the exam problems may require knowledge of all the information presented in the lectures, discussions, and textbook, along with the prerequisite knowledge in general chemistry, physics, and mathematics.

**Class Preparation:** In order to understand the material presented during lectures and discussions, it is important to come to the class with good background knowledge. This can be achieved by reading (and thinking about) material in the textbook, reviewing appropriate material from calculus, physics, and general chemistry classes, and solving end-of-chapter problems. Work together with your classmates; if you don't understand something, someone else may. You will also find that explaining a solution to your classmate will improve your understanding and long-term retention of the material. I cannot overstate how much more useful the classes will be if you come into the room well prepared, and even better, with questions for me and your fellow classmates. The three keys to success in physical chemistry are reading the text, solving as many problems as possible, and asking questions! Ask me questions about the material in class and office hours and ask your classmates questions. It is recommended that students devote to the preparation for this class a minimum of one hour every day.

**Course Structure and Online Class Specifics:** There are two 75-minute lectures (Tuesday and Thursday) and a single 50-minute discussion section (Tuesday) per week. The discussion section will be small group work. You will work in small groups (3-4 people) on problems, with the goal of working with your classmates to learn the material. In the first two weeks of the semester, the lectures and discussions will be delivered through the “Zoom” tool on Sakai and will be recorded in keeping with the statement shown

below. Afterwards the lectures and discussions will be delivered on campus. The office hours will be accessed by the “Office Hours” tool on Sakai. It is highly recommended that you **complete** (and think about) the assigned reading in the textbook **BEFORE** the lecture covering such content, and ask relevant questions during the lectures, discussions, and office hours. Materials from the course, including the exam problems, cannot be shared outside the course without the instructor’s written permission.

**Spring 2022 Masking Requirement:** It is Departmental policy that, even in the event the University relaxes its universal requirement for indoor mask-wearing during the Spring 2022 semester, it will remain a principle of this class section that, out of respect for the health of housemates and others in regular contact with members of our community, in this class we properly wear masks at all times (e.g. over nose and mouth).

**Recording of Zoom class meetings:** In this class software will be used to record live class discussions. As a student in this class, your participation in live class discussions will be recorded. These recordings will be made available only to students enrolled in the class, to assist those who cannot attend the live session or to serve as a resource for those who would like to review content that was presented. All recordings will become unavailable to students in the class when the Sakai course is unpublished (i.e. shortly after the course ends, per the [Sakai administrative schedule](#)). *Students will be required to turn on their cameras at the start of class. Students who have a need to participate via audio only must reach out to me to request audio participation only without the video camera enabled.* The use of all video recordings will be in keeping with the University Privacy Statement shown below.

**Privacy Statement:** Assuring privacy among faculty and students engaged in online and face-to-face instructional activities helps promote open and robust conversations and mitigates concerns that comments made within the context of the class will be shared beyond the classroom. As such, recordings of instructional activities occurring in online or face-to-face classes may be used solely for internal class purposes by the faculty member and students registered for the course, and only during the period in which the course is offered. Students will be informed of such recordings by a statement in the syllabus for the course in which they will be recorded. Instructors who wish to make subsequent use of recordings that include student activity may do so only with informed written consent of the students involved or if all student activity is removed from the recording. Recordings including student activity that have been initiated by the instructor may be retained by the instructor only for individual use.

**Grade Components:** There will be several homework assignments, three tests, and the final exam. Each test is worth the same number of points, **with the lowest score will be dropped.** *There will be no make-up tests or exams.* In the end, the class score is calculated based on the following components:

Homework assignments:	20%
Tests:	40%
Final exam:	40%

Finally, the class score will be rounded to the nearest integer, and then the course grade will be determined based on the class score through the following scale:

Fixed scale	Grade
score $\geq$ 85	A
$80 \leq$ score $<$ 85	A-
$75 \leq$ score $<$ 80	B+
$70 \leq$ score $<$ 75	B
$65 \leq$ score $<$ 70	B-
$60 \leq$ score $<$ 65	C+
$55 \leq$ score $<$ 60	C
$50 \leq$ score $<$ 55	C-
$45 \leq$ score $<$ 50	D
score $<$ 45	F

**Midterm Grade:** Your midterm grades will be obtained based on test(s) (80%) and the homework (20%) according to the method described above.

**Homework:** You will have several homework assignments to complement the materials covered in the class. The homework assignments will be graded for completeness. You will have 5 days to finish each homework assignment. Due date may be postponed for excused absences that last three or more days. Late homework turned in within 72 hours of the due time will receive 50% of the credits, while late homework turned in after 72 hours of the due time will receive zero points.

**Tests:** We will have three tests. You will have 24 hours to complete each test. They will be open note and book, but no other resources will be allowed. These will typically be opened on a Thursday, and due the next day. If a student disagrees with her/his score for the test, she/he must request re-grading *within one week* from the day she/he received the graded test.

**Final Exam:** The University sets the schedule for all final exams. The final exam will be held on: **Tuesday, May 3, 2022 at 1:00 PM (CST)**. You will have exactly 2 hours to complete the exam. Additional time will not be granted, even if you start late. There will be no make-up final exams given under any circumstance, and the exam will not be given early, either. Instructors may not reschedule final exams for a class for another day and/or time during the final exam period. There can be no divergence from the posted schedule of dates for final exams. Individual students who have four (4) final examinations scheduled for the same date may request to have one of those exams rescheduled. If a student reports having four final examinations scheduled for the same date, students should be directed to e-mail a petition to Adam Patricoski, Assistant Dean for Student Academic Affairs, CAS Dean's Office ([apatricoski@luc.edu](mailto:apatricoski@luc.edu)). If a student disagrees with her/his score for the final exam, she/he must request re-grading *within four days* from the day he/she received the graded final exam.

#### **Health, Safety, and Well-Being On-Campus:**

Please be familiar with and adhere to all policies and protocols posted on the Campus Info & Resources site: <https://www.luc.edu/healthsafetyandwellbeing/campusinforesources/>

#### **Ethical Considerations:**

a. Academic integrity: All students in this course are expected to have read and to abide by the demanding standard of personal honesty, drafted by the College of Arts and Sciences, which can be viewed at:

<http://www.luc.edu/cas/advising/academicintegritystatement/>

A basic mission of a university is to search for and to communicate the truth as it is honestly perceived. A genuine learning community cannot exist unless this demanding standard is a fundamental tenet of the intellectual life of the community. Students of Loyola University Chicago are expected to know, to respect, and to practice this standard of personal honesty.

Academic dishonesty can take several forms, including, but not limited to cheating, plagiarism, copying another student's work, and submitting false documents.

Any instance of dishonesty (including those detailed on the website provided above or in this syllabus) will be reported to The Chair of The Department of Chemistry and Biochemistry who will decide what the next steps may be.

b. Tests and Exams: Students will not collaborate on any tests or exams. Only those materials and devices permitted by the instructor may be used to assist in tests or exams. Students will not represent the work of others as their own. Any student caught cheating during a test or exam will be reported to the Dean's office and will receive zero points for the given test or exam. The Chair of the Department of Chemistry and Biochemistry will also be notified and will decide what the next steps may be. Please be honest with your work.

c. Teamwork: I strongly encourage you (the class) to work together to solve assigned and unassigned

problems. In order to learn and excel in Physical Chemistry, you should work through problems. The assigned problems are a minimum. Work together with your classmates, if you do not understand something, someone else may. You will also find that explaining a solution to your classmate will cement the information in your mind, and make you a better student. When working as a group, if each member contributes to the discussion, and you each hand in very similar work, that is perfectly acceptable given the nature of the assignments. On the other hand, if someone simply copies an assignment from someone else, that is plagiarism, and will be treated as such. Any students caught plagiarizing for an assignment will receive zero points on the given assignment. The Chair of the Department of Chemistry and Biochemistry will be notified and will decide what the next steps may be.

**Loyola University Absence Policy for Students in Co-Curricular Activities (including ROTC):**

Students missing classes while representing Loyola University Chicago in an official capacity (e.g., intercollegiate athletics, debate team, model government organization) shall be allowed by the faculty member of record to make up any assignments and to receive notes or other written information distributed in the missed classes. Students should discuss with faculty the potential consequences of missing lectures and the ways in which they can be remedied. Students must provide their instructors with proper documentation i.e., "[Athletic Competition & Travel Letter](#)" describing the reason for and date of the absence. This documentation must be signed by an appropriate faculty or staff member and it must be provided to the professor in the first week of a semester. It is the responsibility of the student to make up any assignments. If the student misses an examination, the instructor is required to allow the student to take the examination at another time. (<https://www.luc.edu/athletheadvising/attendance.shtml>) Students who will miss class for an academic competition or conference must provide proper documentation to their instructor as early in the semester as possible.

**Student Accommodations:** The Student Accessibility Center (formerly known as Services for Students with Disabilities), Sullivan Center (773-508-3700), <http://www.luc.edu/sac>, has the mission "to support, service, and empower Loyola University Chicago students with disabilities" and to "Partner with faculty and staff to provide opportunities for collaboration, professional development, personal growth, and staff interaction, as they relate to students with disabilities." Please direct all questions concerning accommodations of disabilities to the Student Accessibility Center. Academic accommodations afforded to students require documentation and review. The Student Accessibility Center will issue accommodation letters for registered students to present to their instructors: accommodations are not active until students present these letters to their instructors. If students' accommodations involve attendance or deadlines, instructors and students will jointly complete and execute an Agreement Form articulating their terms. See <https://www.luc.edu/sac/faculty/facilitatingaccommodations/> for guidance about implementing various kinds of accommodations in a way that is appropriate to your class. The Student Accessibility Center stands ready to work with you.

**Accommodations for Religious Reasons:** If you have observances of religious holidays that will cause you to miss class or otherwise effect your performance in the class you must alert the instructor **within 10 calendar days of the first class meeting of the semester** to request special accommodations, which will be handled on a case by case basis.

**Pass/Fail Conversion Deadlines and Audit Policy:** A student may request to convert a course into or out of the "Pass/No-Pass" or "Audit" status only within the first two weeks of the semester. For the Spring 2022 semester, students are able to convert a class to "Pass/No-Pass" or "Audit" through Monday, January 31st. Students must submit a request for Pass/No-Pass or Audit to their Academic Advisor.

**Course Repeat Rule:** Effective with the Fall 2017 semester, students are allowed only THREE attempts to pass Chemistry courses with a C- or better grade. The three attempts include withdrawals (W). After the second attempt, the student must secure approval for a third attempt. Students must come to the Chemistry Department, fill out a permission to register form or print it from the Department of Chemistry and Biochemistry website: <http://www.luc.edu/chemistry/forms/> and personally meet and obtain a signature

from either the Undergraduate Program Director, Assistant Chairperson, or Chairperson in Chemistry. A copy of this form is then taken to your Academic Advisor in Sullivan to secure final permission for the attempt.

**The Loyola Official Academic Calendar:** [www.luc.edu/academics/schedules](http://www.luc.edu/academics/schedules)

**The Loyola COVID-19 Website:** <https://www.luc.edu/coronavirus/>

**The Return to Campus Website:** <https://www.luc.edu/returntocampus/>

- Checklist: <https://www.luc.edu/returntocampus/checklist/>

**Center for Student Assistance and Advocacy:** <https://www.luc.edu/csaa/>

**Student Services at Loyola Online:** <https://www.luc.edu/online/resources/index.html>

- Student Complaint Procedure: <https://www.luc.edu/online/resources/student-grievances/>
- Technology Support, including Sakai, Zoom, and LOCUS:  
<https://www.luc.edu/online/resources/technology/>
- Academic Services, including the Center for Tutoring and Academic Excellence, and the Writing Center: <https://www.luc.edu/online/resources/academicservices/>
- Student Support Services, including the Student Accessibility Center, and the Wellness Center:  
<https://www.luc.edu/online/resources/student-support-services/>

**Tentative Schedule\***

Week	Dates	Lecture Topics	Reading
1	Tuesday Jan 18	Syllabus, the Boltzmann distribution	Syllabus, Topic 13A
	Thursday Jan 20	Origins of quantum mechanics	Topic 7A
2	Tuesday Jan 25	Wavefunctions	Topic 7B
	Thursday Jan 27	Operators and observables	Topic 7C
3	Tuesday Feb 1	Translational motion	Topic 7D
	Thursday Feb 3	Vibrational motion	Topic 7E
4	Tuesday Feb 8	Rotational motion	Topic 7F
	Thursday Feb 10	Hydrogenic atoms	Topic 8A
5	Tuesday Feb 15	Many-electron atoms	Topic 8B
	Thursday Feb 17	Atomic spectra	Topic 8C
6	Tuesday Feb 22	Valence-bond theory	Topic 9A
	Thursday Feb 24	Molecular orbital theory	Topic 9B
7	Tuesday Mar 1	Molecular orbital theory: diatomic molecules	Topics 9C & 9D
	Thursday Mar 3	Molecular orbital theory: polyatomic molecules	Topic 9E
8	Tuesday Mar 8	<i>No Classes; Spring Break</i>	
	Thursday Mar 10		
9	Tuesday Mar 15	Shape and symmetry	Topic 10A
	Thursday Mar 17	Group theory	Topic 10B
10	Tuesday Mar 22	Applications of symmetry	Topic 10C
	Thursday Mar 24	General features of molecular spectroscopy	Topic 11A
11	Tuesday Mar 29	Rotational spectroscopy	Topic 11B
	Thursday Mar 31	Vibrational spectra of diatomic molecules	Topic 11C
12	Tuesday Apr 5	Vibrational spectra of polyatomic molecules	Topic 11D
	Thursday Apr 7	Symmetry analysis of vibrational spectra	Topic 11E
13	Tuesday Apr 12	Electronic spectra	Topic 11F
	Thursday Apr 14	Decay of excited states	Topic 11G
14	Tuesday Apr 19	General principles of magnetic resonance	Topic 12A
	Thursday Apr 21	Features of NMR spectra	Topic 12B
15	Tuesday Apr 26	Pulse techniques in NMR	Topic 12C
	Thursday Apr 28	Electron paramagnetic resonance	Topic 12D
<b>Final exam: Tuesday May 3, 1:00-3:00 PM (CST)</b>			

\*The instructor reserves the right to make changes to the schedule, except the date and time of the final exam. Any changes to other exam dates will be announced in class and on Sakai. Reading assignments are from the textbook unless noted otherwise.